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SUBJECT: Comments on NRC Contractor Draft Report, LA-UR-XXX, *GSI-191: Parametric Evaluations for Pressurized Water Reactor Recirculation Sump Performance*

PROJECT NUMBER: 689

This letter provides NEI's comments on the NRC contractor draft report, LA-UR-XXX, *GSI-191: Parametric Evaluations for Pressurized Water Reactor Recirculation Sump Performance.* These comments were developed with input from the NEI PWR SUMP Performance Task Force and are offered in response to the NRC staff's invitation to comment on the draft report. We understand that this report will be used as an input to the NRC staff's disposition of generic safety issue GSI-191, *Assessment of Debris Accumulation on PWR Sump Performance.*

As a general comment, the draft report lacks sufficient information to permit independent evaluation of the work performed. Our review concludes that:

- The report provides graphical summaries of the results obtained from the application of the evaluation methodology, however it does not identify details of this methodology.
- Assumptions are stated, but bases for those assumptions are not provided (why they are applicable and/or appropriate).
- Governing equations (mathematical models) are not given.
- Inputs to calculations are described only in general terms; detailed listing of specific inputs is not given. Alternate sources of information are described, but the input values are not identified.
- Applicability limits are discussed only in general terms. Typically, the discussion is provided in terms of information not available to NRC and its

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contractor and the approach taken by NRC to address the lack of information.

- Open items, such as unverified assumptions, assumptions made due to lack of plant design or operating information, etc., were not clearly identified. Consequently, we have been unable to assess the impact of these open items and resulting conclusions.

In summary, without greater detail, the specific conclusions drawn in the report are difficult to corroborate. However, we recognize that additional detail was provided during the discussion at the July 26 and 27, 2001 public meeting. This detail should be incorporated into the final report. Furthermore, we anticipate that the NRC will be providing further documentation of its research in several NUREGs that are being prepared. Detailed comments on the draft report are provided in Table 1.

We recommend that that the NRC revise the report by addressing the general comments discussed above and detailed comments provided in Table 1. In addition, we propose that the revised report and the associated NUREGs be issued for public comment prior to it being used to as an input to the disposition of GSI-191.

At the July meeting, the NRC presented a preliminary risk analysis associated with PWR sump performance. The draft report did not include risk analysis information. Several of the comments provided in Table 1 are related to the preliminary risk analysis. We request that NRC consider these comments as they complete their risk analysis. We propose a meeting with the NRC staff to discuss the risk methodology and assumptions. We believe this meeting should be conducted prior to the disposition of GSI-191.

If you have questions or wish to discuss these comments, please contact Kurt Cozens at (202) 739-8085, koc@nei.org, or me.

Sincerely,

Alexander Marion

KOC/maa
Enclosure

c: Mr. Robert B. Elliot, U. S. Nuclear Regulatory Commission
Mr. Frank P. Gillespie, U. S. Nuclear Regulatory Commission
Mr. Michael L. Marshall, Jr., U. S. Nuclear Regulatory Commission

TABLE 1
COMMENTS ON
LA-UR-XXX, GSI-191: *PARAMETRIC EVALUATIONS FOR PRESSURIZED WATER REACTOR RECIRCULATION SUMP PERFORMANCE* (DRAFT)

Comment No.	Comment
1	As discussed at the July 26 and 27 public meeting: 1) Confirm that the "Zone Of Influence" used to estimate the region of debris generation accounts for physical barriers, such as a crane wall or refueling canal, for the sixty-nine (69) cases evaluated in the draft report. 2) Identify if any cases have been reevaluated so as to account for these physical barriers, and if so, the impact on the conclusions drawn for these cases.
2	The draft report states that "numeric simulations" confirm the selection of ½ the pool height as the "failure criteria" for partially submerged sump screens. Additional information and/or references should be added to the report, which provide the basis for the chosen failure criteria.
3	The study acknowledges that time was not taken into account. The element of time is important, and should be accounted for in considering the timing of the sequence of events attributing to debris generation, transport to the sump and subsequent postulation of sump screen blockage. Other comments associated with time are provided in this table.
4	The transport fraction for pool transport was determined utilizing observations from the tank tests and the flume tests conducted at the University of New Mexico. If this understanding is correct, appropriate consideration may not have been given to establishing the conditions required for similitude between the tank tests and a representative containment. The quoted test flow rates produced velocities that approximate the velocities expected in plants. However, there are many other significant differences between the tests and plants. These include: 1) Containment pool vs. tank volume, which effects volume exchange time and time for transport of debris to the sump screen. The volumetric turnover in the test is about five to seven (5 – 7) times for each turnover expected for a representative plant. 2) Differences between introduction of water into pools in the test articles (all in one location) versus the plant (break location, overflow from refueling canal, runoff from containment walls and floors). This results in tests having higher local turbulence levels in the pool, which promotes both the suspension of particulates and, possibly, fibrous debris, as well as the transport of those debris to the sump screen. 3) Increases in turbulence levels in the tests compared to the plants due to the non-linear scaling of turbulence associated with linear scaling between test models and the prototype. The increase in local turbulence levels in the tests, promotes the suspension and transport of both particulates and, possibly, fibrous debris.

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	4) Basis for both the amount and the composition (debris make-up; % RMI, % fibrous, etc.) of debris used in the tank tests compared to plants. If the tank test were to be used as a guide for transport fraction, good test practice would suggest that approximately proportionate debris would be introduced into the flow stream for the test as would be expected in the plant. 5) The fraction of debris transported to the sump by spray washdown was given as 75%. This value may not be representative as the spray nozzles are installed so as to deliver the majority of the spray inventory to the operating deck floor. From there, the fluid is (generally) ducted into the refueling canal where additional settling of particulates and potential entrapment of fibrous debris might occur. It is recommended that this comment be addressed in the final report.
5	The head loss correlation given in NUREG/CR-6224 suggests the use of various physical parameters for each of the constituents of the debris bed, e.g. fiber diameter, particulate diameter, macro and microscopic densities, etc. Neither the report nor the presentation at the July meeting identified the debris characteristics used in calculating the NUREG/CR-6224 head loss correlation. These should be included in the report.
6	The methodology of NUREG/CR-6224 uses a high filtration efficiency for fibers. For particulates, the filtration efficiency is proportional to the fiber bed thickness. Significant overestimation of head loss can occur if high filtration efficiency is used for particulates. The filtration efficiency for the different debris used in the head loss calculations should be included in the report.
7	Compaction of the debris bed may be a critical factor in determining head loss through the debris bed. 1) It was not clear from the draft report what was assumed for debris bed compaction in the calculation of head loss across the debris bed. 2) NUREG/CR-6224 indicates that the head loss correlation may over-predict head loss for thin beds coupled with high particulate-to-fiber mass ratios. Was this over-prediction addressed in the determination of thin bed head loss and if so, a description should be included in the report?
8	During the public meeting, industry representatives identified several conservative assumptions and approaches used in the draft. The NRC contractor generally acknowledged this with statements that there were one or more orders of magnitude difference between the estimated head loss and allowable margin. This large difference was given as the basis for not evaluating the impact of these conservative assumptions. This was the general response by the contractor. We recommend that the report discuss these conservatisms and the impact to estimated head loss and allowable margin.

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9[1]	It is unclear why RCP Seal LOCA was categorized as a particular size of LOCA when other mechanical-failure-induced LOCAs (e.g., stuck/spuriously opened primary relief or safety valve, as listed on Slide #4 of the PRA presentation) were not. The rationale for concluding that a difference exists between debris-generation mechanisms for RCP Seal LOCA and other small LOCAs should be provided.
10[1]	There is a note indicating that the NUREG/CR-5750 large LOCA frequency has been updated to account for the V.C. Summer piping weld crack. What was the basis for assignment completely to the large LOCA category (as opposed to medium or small categories)?
11[1]	Consideration of seismically induced LOCAs is included in the assessment. However, as potential seismic impacts are highly site-specific, the consideration of such events would generally also require the consideration of plant location as a parameter, unless the objective is to perform a "bounding" assessment (i.e., not particularly realistic for any plant site). It was not clear, purely from slides how the seismic effects are being factored into the overall assessment and how these effects might influence the resulting cost-effectiveness decisions. Additional discussion of this topic is requested.
12[1]	The seismic initiating event frequency assigned to the Large LOCA category seems high. The category of events are those seismic events for which there is a high confidence that a consequential primary pipe break in the large size range would occur. As noted in question #10, this is a function of plant location, and the seismic fragilities of plant systems, structures, and components (SSCs). Aside from the fact that no detail is provided regarding how these issues are being accounted for, the magnitude of the frequency assigned for seismic Large LOCA seems inconsistent with the values assigned for medium and small LOCA categories. Additional discussion of this topic is requested.
13[1]	There is a note indicating that the "old (1988) LLNL hazard curves" from NUREG-1150 (Surry) are being used. What is the basis for selection of this particular hazard curve? Uncertainties in the debris accumulation study related to use of this particular seismic hazard curve should be addressed in the report.
14[1]	It is not clear how the "RECIRC" and "NON-RECOVERY" events are being used in the assessment relative to the probabilities being assigned. In many PWR PRAs, sequences requiring ECCS injection also require successful ECCS recirculation to result in a "success" end state (i.e., no core damage). Further, in these PRAs, any small LOCA sequence is generally modeled as requiring ECCS injection for success. Procedurally driven alternatives are usually not considered, since they would require significant plant and scenario-specific involving human actions with sufficiently significant failure probabilities such that default to the

[1] This comment address the NRC staff risk presentation made during the July 26 and 27, 2001 public meeting.

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	recirculation scenario is likely. 1) For the Small LOCA assumptions, it is not clear what the assigned "RECIRC" probabilities represent, or how they were assigned, particularly for the large dry containment case. Additional discussion of this topic is requested. 2) For both the Small LOCA and the RCP Seal LOCA cases, is "NON-RECOVERY" equivalent to failure of ECCS recirculation in the absence of consideration of debris-related sump blockage, or failure of ECCS recirculation including consideration of debris effects? 3) The values listed for "NON-RECOVERY" probabilities seem high if this event is intended to be ECCS recirculation failure (given successful ECCS injection) without consideration of debris-related blockage effects, especially for plants with automatic switchover to recirculation on low RWST (refueling water storage tank) level. Additional discussion of this topic is requested. 4) For the case of RCP Seal LOCA, there is a high likelihood that the resulting leak will be sufficiently small that the event is effectively a Very Small LOCA (in which case the assumption on Slide #5 regarding no recirculation requirement applies). In this case, the assigned "RECIRC" probabilities make sense. 5) It is unclear why the plant response postulated for ice condenser plants following Small LOCA is different than that postulated for RCP Seal LOCA (i.e., "RECIRC" probability = 0.43 for RCP Seal LOCA but = 1.0 for Small LOCA). Given the overlapping ranges of possible break size equivalents for these two events, the application of different probabilities implies some unstated assumptions regarding distribution of events within these size ranges. Otherwise, it would seem that the same probabilities would apply. Additional discussion of this topic is requested. 6) For the Sub-atmospheric containment Small LOCA case, it is not clear how the differentiation in assigned "RECIRC" probability (relative to the other cases) is justified. Failure of RHR, which is environmentally qualified, is not guaranteed given actuation of containment spray; further, failure of RHR does not guarantee failure of ECCS recirculation cooling, since plants with sub-atmospheric containments typically have a second system (e.g., recirculation spray cooling system) to provide recirculation cooling.
15[1]	How were values shown for the parametric evaluation of probability of sump clogging selected? The values shown imply that, unless there is no chance of clogging (i.e., P=0, the "unlikely" case), there is a significant chance of clogging (i.e., P=0.3, the "possible" case). The values selected do not appear to represent a reasonable probability distribution, unless the research results indicate an extreme sensitivity of clogging to the presence/generation of any debris at all. Changing the assigned probabilities by factors of ~2 is not likely to produce insights. Unless there is always a significant chance of clogging the sump screen and the probability is not zero, then a more meaningful selection of values for this sensitivity might be P=1.0, P=0.1, P=0.01 or 0.001, and P=0.
16[1]	Slide 11 of the PRA presentation gave the impression that the assessment of Monetized Benefits from Averting Accidents Associated with Sump Clogging is being

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	performed in a way that maximizes impact (and therefore maximizes benefits of aversion). This can be a valid approach, depending on the decision that the risk assessment is intended to support. That is, if the intent were to figure out what the worst possible effect could be in order to determine whether or not a more detailed estimate is needed, then a bounding approach is useful as a first (and potentially only) step. But if it is already known that a better estimate will be needed, then more realistic assumptions (and associated ranges or sensitivities to cover various cases) would be expected. The information on Slide 11 suggests that the population dose analysis being applied is conservative in several ways. Stated conservatisms include application of effects of a scenario in which failure was during injection rather than recirculation and assignment of effects from Small LOCA to all events. Other conservatisms appear to be application of the Zion population density (even at the 80th percentile) as representative of all plants (many of which would have much lower population densities). Further, the statement that "The [results for the?] large dry containment type of plant may be optimistic for some plants …" seems to imply an inconsistent distinction of a particular plant characteristic that might result in less bounding results within this process, given the apparent application of layers of conservatisms elsewhere in the assessment. The risk evaluation should use realistic assumptions, with sensitivities, rather than conservative assumptions when applied to the Monetized Benefits assessment
17	At the February 14, 2001 public meeting on GSI-191, industry identified a basis for using initiating event frequencies based on industry-sponsored Risk Based In-Service Inspection (RB-ISI) and break opening times from public literature. At that meeting, NRC was requested to identify how they would disposition that industry information. These event frequencies should be used in the risk assessments used in evaluating the significance of this issue.
18	At the February 14, 2001 public meeting on GSI-191, industry presented data that coatings failures reported by Savannah River Technical Center were beyond the conditions expected to occur in a PWR containment under normal and design basis accident conditions. The draft report specifically identifies the SRTC observations as a possible debris source. Based on this data the reference to the SRTC data should be removed from the report, since it is not applicable to plant operations.